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Final Project Report
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Intergraph IGDS to *Jack*/Peabody Geometry Translator

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1 Introduction and Motivation

The problem is to translate Intergraph IGDS CAD format geometry and attributes files to the *Jack*/Peabody format. IGDS is used to define complex objects, such as space station, payloads, facilities, etc. *Jack* is a human modeling program that allows the insertion, manipulation, and animation of anthropometrically-scaled computer graphics human figures into a geometric environment. The translator was needed in order to perform *Jack* human factors analyses (fit, reach, vision, range of motion, collision, etc.) on Intergraph IGDS modeled environments characterized by high geometric complexity and presence of multiple human technicians.

The IGDS format is a proprietary format based on entities and geometric operations on the entities. The *Jack* geometric format consists solely of polygons. Also, the Peabody hierarchy is much richer than the IGDS connectivity structure.

Other geometry translators (i.e. IGES/*Jack*) have been developed by the University of Pennsylvania through a subcontractor, DRaW Computing Associates, Inc. These translators have relied on tesselation of parameterized entities, as well as creation of a Peabody hierarchy

from limited input. The methods are similar to translation of IGDS data, and IGDS data can be translated to *Jack* through use of IGES as an intermediate format.

The IGES/*Jack* translator is an indirect method of translating IGDS data through an intermediate format. Due to limitations in the IGES format itself, this is not an acceptable method for translating large amounts of IGDS data.

2 The Technology Applied to the Problem

An Intergraph IGDS CAD format to *Jack* geometric translator was developed. The user specifies computer files to be translated and may specify criteria for translation. This includes which entities are to be translated, scale factors, tesselation parameters, floating point "fuzz" values, coordinate systems, and joint placement.

The software development on this project has been completed on schedule. All NASA-defined required IGDS entities are supported. The stand-alone software program "ig" performs translation. Command line inputs or a graphical user interface operates the translation of individual IGDS files producing *Jack* environment, figure, and psurf (geometric) files as output. The implementation is based on current practices in 3-D graphics, splines, and homogeneous operations. There are user-selectable tolerances for translation. The software runs on Silicon Graphics workstations and is supported by the University of Pennsylvania, Center for Human Modeling and Simulation.

3 Features of the Technology

The Intergraph IGDS proprietary format is not fully specified in the available documentation, and the file format contains display data and not the original creation data for complex entities. This is assumed to be due to Intergraph's desire to keep their format proprietary. For example, a complex entity created by revolving a circle is stored as a group of circles connected by arcs from the rotation. This is inadequate if another tesselation resolution is required.

Because the IGDS format is not fully specified, several features of the format had to be determined through experimentation. This includes determination of the knot sequence for splines. In addition, complex geometric entities based on operations on primitives are stored in display format. Due to the need to provide the user with selectable tesselation parameterization, the original geometric operations and specification had to be determined from the display format. In essence, this required a reverse-engineering of the resulting model.

Geometry translation can be interactive or batched. Successful translation has been performed by NASA on IGDS created space-station and payload support equipment and facilities data.

The IGDS translator provides an easy, direct method of translating IGDS files to Peabody format for importing into *Jack*. The major shortcoming is that not all entities are supported by the translator, most notably trimmed parametric surfaces. The software does, however, meet the required specifications and has proved very useful for bringing *Jack* human factors analyses into Intergraph-built CAD environments.